



Study on Tullbergiidae of Tibet, China II. *Metaphorura zhongi* sp. n. from Sejila Mountain (Hexapoda, Collembola)

Yun Bu^{1✉}, Yan Gao²

1. Natural History Research Center, Shanghai Natural History Museum, Shanghai Science & Technology Museum, Shanghai, 200041, China.

2. Shanghai Hengjie Chemical Co. Ltd., Shanghai, 201599, China

✉ **Corresponding author:**

Yun Bu

Email: buy@sstm.org.cn

Phone: +86-021-68622000

Address: 399 Shanhaiguan road, Shanghai 200041, China

Article History

Received: 2 November 2018

Accepted: 30 January 2019

Published: April 2019

Citation


Yun Bu, Yan Gao. Study on Tullbergiidae of Tibet, China II. *Metaphorura zhongi* sp. n. from Sejila Mountain (Hexapoda, Collembola). *Species*, 2019, 20, 84-89

Publication License



© The Author(s) 2019. Open Access. This article is licensed under a [Creative Commons Attribution License 4.0 \(CC BY 4.0\)](https://creativecommons.org/licenses/by/4.0/).

General Note

 Article is recommended to print as color digital version in recycled paper.

ABSTRACT

Metaphorura zhongi sp. n. from Sejila Mountain of Tibet is described and illustrated. It is characterized by the presence of 1+1 pseudocelli on thoracic segment I, few elongate vesicles (17–18) on PAO, pseudocellar formula as 11/122/22221, all pseudocelli as type II, absence of seta p4 on abdominal segment IV, weakly differentiated sensory seta p3 on abdominal segment V and small

median process on abdominal segment VI. It is similar to *M. denisi* in the formula of pseudocelli and shape of postantennal organ, but differs in the chaetotaxy of abdominal segment IV–VI and the number of setae on the tibiotarsi I and II.

Keywords

Postantennal organ, pseudocelli, sensillum, chaetotaxy, taxonomy, tibiotarsi

1. INTRODUCTION

Tibet is one of the biodiversity hotspots in the world, however, the species diversity of soil-dwelling arthropods, for instance, springtails and pauropods are still poorly known (Bu & Gao, 2017; Qian et al., 2018). In our first contribution of collembolan from Tibet, four species of Tullbergiidae, *Metaphorura motuoensis* Bu & Gao, 2017, *Mesaphorura yosii* (Rusek, 1967), *Mesaphorura hylophila* Rusek, 1982 and *Prabhergia imadatei* Tamura & Zhao, 1996 were reported from Southeast Tibet (Bu & Gao, 2017). During the identification of collembolan specimens from Sejila Mountain of Tibet, a new species of genus *Metaphorura* Bagnall, 1936 was found and is described in the present paper. The present paper is our second contribution of collembolan from Tibet.

2. MATERIALS AND METHODS

Specimens were extracted by Berlese-Tullgren funnels and preserved in 80% ethanol. The material was mounted on slides in Hoyer's solution and dried up in an oven at 50°C for identification. Observations were done with a phase contrast microscope (Leica DM 2500). Photos were taken by a digital camera installed on the microscope (Leica DMC 4500). Line drawings were drawn using a drawing tube. Type specimens are deposited in the collections of Shanghai Natural History Museum (SNHM), China. In the description we use the nomenclature for morphological features following Dunger & Schlitt (2011). Pseudocellar types after Weiner & Najt (1991). Antennal chaetae notation after Rusek (1971). Formula of tibiotarsal chaetotaxy after Fjellberg (1991).

Abbreviations in description: **Th.** – thoracic segment, **Abd.** – abdominal segment, **Ant.** – antennal segment, **Asp.** – anal spine, **s** – sensillum, **ms**– microsensillum, **PAO**– postantennal organ, **a** – anterior setae, **m** – medial setae, **p** – posterior setae, **pl**– pleural setae, **pso**– pseudocelli.

3. RESULTS

Taxonomy

Genus *Metaphorura* Bagnall, 1936

Type species: *Tullbergia affinis* Börner, 1902

Metaphorura zhongi sp. n. (Figs. 1–2, Table 1)

Material examined

Holotype, male (slide no. XZ-C2015063) (SNHM), China, Tibet, Linzhi, Sejila Mt., extracted from soil samples of broad-leaved forest, Alt. 3500 m, 29°67'N 95°70'E, 1-XI-2015, coll. Y. Bu & G. Yang; paratype, 1 male (slide no. XZ-C2015118) (SNHM), same data as holotype.

Table 1 Dorsal Chaetotaxy of *Metaphorura zhongi* sp. n.

| row | Thorax | | | Abdomen | | | | |
|-----|--------|----|-----|----------------|----------------|----------------|----------------|-----------------|
| | I | II | III | I | II | III | IV | V |
| a | - | 10 | 10 | 10 | 10 | 10 | 10 | 10 ⁴ |
| m | 8 | 8 | 8 | 2 ¹ | 4 ² | 4 ² | 4 ² | - |
| p | - | 8 | 8 | 10 | 10 | 10 | 8 ³ | 8 ⁵ |
| pl | 2 | 3 | 3 | 2 | 3 | 3 | 6 | 1 |

Notes: -absent; ¹ seta m4 present; ² seta m3 and m4 present; ³ seta p4 absent; ⁴ seta a2 as mesoseta, a4 as macroseta; ⁵ sensory seta p3 not differentiated, seta p4 as microseta.

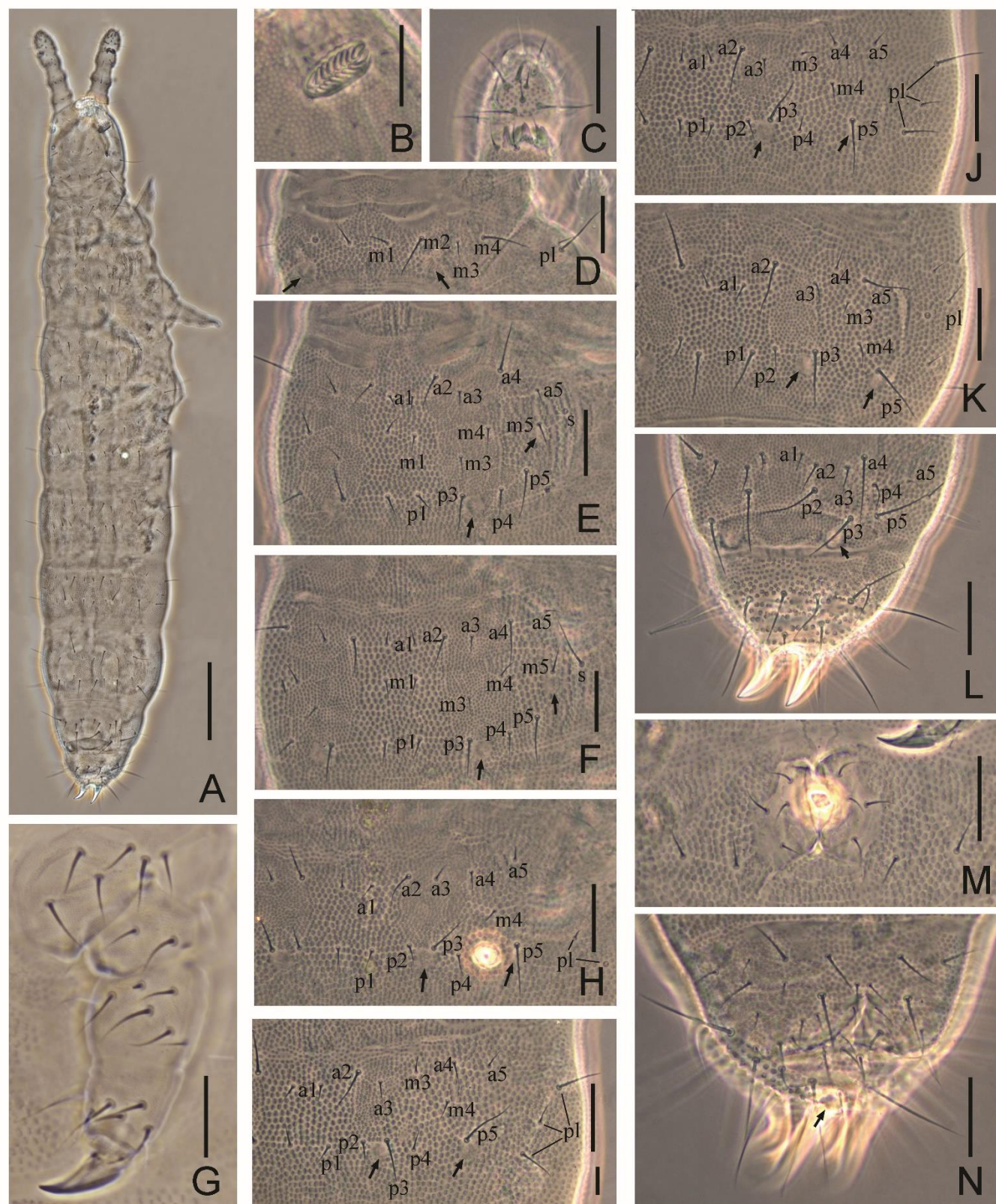


Figure 1

Metaphorura zhongi sp. n. (Holotype) **A.** Habitus, dorsal view; **B.** Right postantennal organ; **C.** Ant. III and IV; **D.** Th. I; **E.** Th. II; **F.** Th. III; **G.** Leg III. **H.** Abd. I; **I.** Abd. II; **J.** Abd. III; **K.** Abd. IV; **L.** Abd. V and VI; **M.** Ventral Tube; **N.** Abd. VI, ventral view. Arrows in figs D–F, H–L indicate the pseudocelli, in fig. N indicates the median process. Scale bars: 100 μm in fig. A, 20 μm in others.

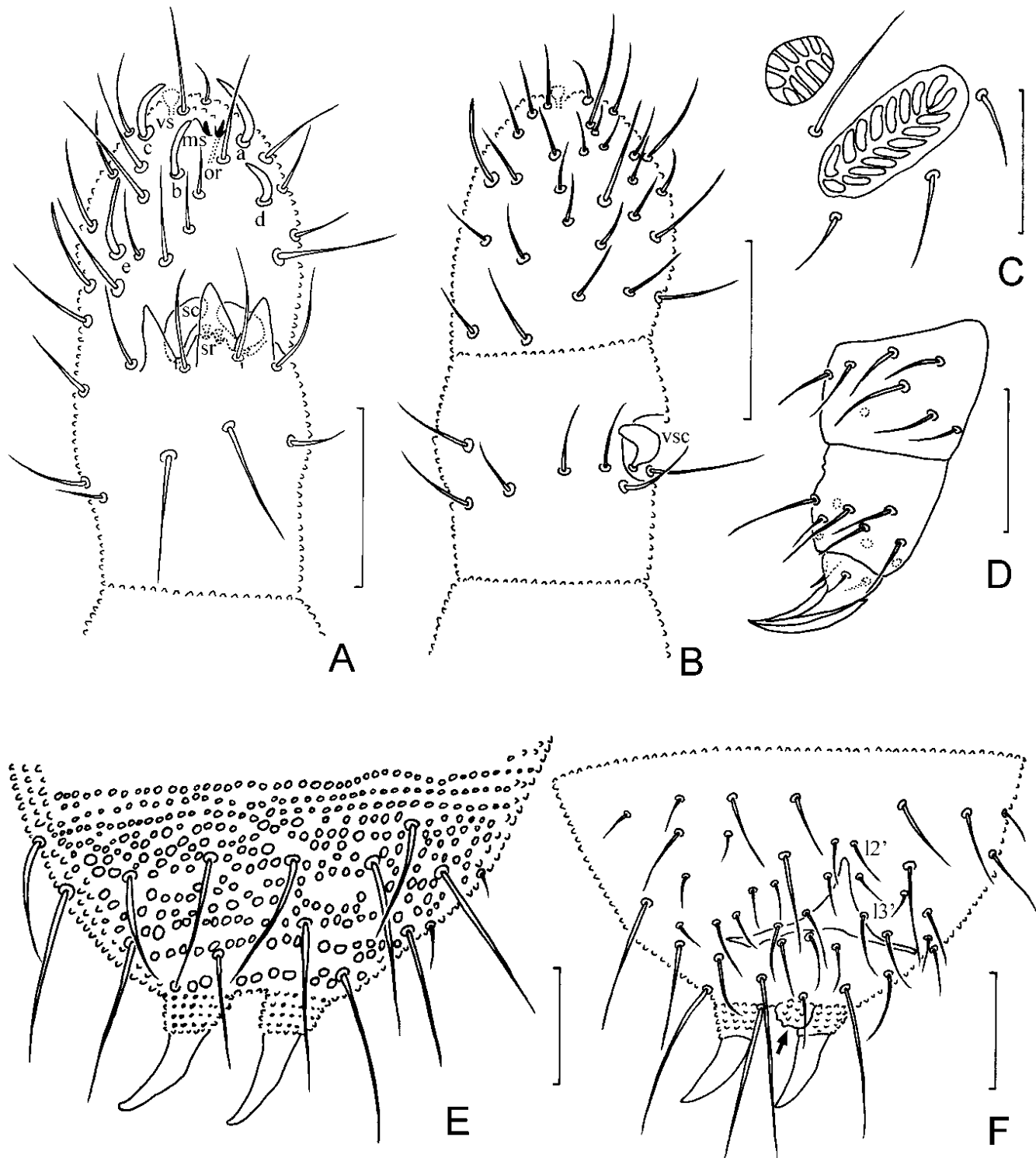


Figure 2

Metaphorura zhongi sp. n. (Holotype) **A.** Antenna, dorsal view, a, b, c, d, e—large sensilla, ms—microsensillum, or—subapical organite, vs— apical vesicles, sc—sensory clubs, sr—sensory rods; **B.** Antenna, ventral view, vsc—ventral sensory club; **C.** PAO and pso on head; **D.** Leg III. **E.** Abd. VI, dorsal view; **F.** Abd. VI, ventral view, arrow indicate the median process. Scale bars: 20 μ m.

Diagnosis

Metaphorura zhongi sp. n. is characterized by the presence of pseudocelli on thoracic segment I, few elongate vesicles (17–18) on PAO, pseudocellar formula as 11/122/22221, all pseudocelli of type II, absence of seta p4 on abdominal segment IV, less differentiated sensory seta p3 on abdominal segment V and small median ventral process on Abd. VI.

Description

Adult body 0.85 mm long in average ($n = 2$), holotype 0.84 mm (Fig. 1A). Setae well differentiated into micro- and macrosetae. Granulation of integument coarse (2.5–3 μm) (Figs. 1D–F, H–N) and becomes stronger on Abd. VI (Fig. 2E). Pseudocellar formula as 11/122/22221. All pseudocelli composed by two rows of parallel stripes in the center (type II, Fig. 2C), 7–8 μm in diameter; on Th. I present between seta m2/m3, close to hind margin of Th. I (Fig. 1D); on Th. II and III, subdorsal one between setae p3/p4, close to p3, lateral one posterior to seta m5 (Figs. 1E, 1F); on Abd. I–IV, subdorsal one posterior to seta p3, lateral one posterior to seta m5 (Fig. 1H–K); on Abd. V, on the border of Abd. VI, posterior to seta p3 (Fig. 1L).

Cephalic seta a0 present (13 μm), c1 absent, oc2 as macroseta (20–22 μm), sd5 as microseta (7 μm). Postantennal organ 18–20 μm long, 9 μm wide, composed of 17–18 elliptical vesicles arranged in two parallel rows, situated in a deep furrow (Figs. 1B, 2C). Labrum with 4/4/2 setae. Labium with five papillae, six apical guard setae, six proximal setae, four basomedian setae, and five basolateral setae. Ventral head with 3+3 axial setae.

Antenna (100 μm) shorter than head (110 μm). Ant. I and II with 7 and 11 setae respectively. Antennal segment IV with five slightly thickened sensilla a–e, sensilla a, b, c, e long and slightly curved toward inside, d short (Fig. 2A). Small microsensillum, subapical organite and one small apical vesicle present (Fig. 2A). Antennal organ III with two small sensory rods between two thick sensory clubs bent toward each other, concealed behind three papillae (Fig. 1C) and four guard setae, and one large ventral sensory club (Figs. 2A, B).

Legs without tenant hairs (Figs. 1G, 2D). Subcoxa, coxa, trochanter, femur and tibiotarsus with 0/3/3, 3/7/7, 5/5/5, 8/8/8, 10/10/10 setae on leg I, II and III, respectively (Figs. 1G, 2D), tibiotarsi each with 6+4 setae (A1 to A6, B4 to B7, and M absent). Anal lobes with setae l2' and l3' (Figs. 1N, 2F). Claw 15–17 μm in length, untoothed, with short empodial appendage (4–5 μm) (Figs. 1G, 2D).

Adult chaetotaxy given in Figs. 1D–1L and Table 1. Thoracic segment I with 8 setae, m1 and m3 9–11 μm , m2 and m4 22–23 μm in length (Fig. 1D). Microsensilla present on Th. II and Th. III, and lateral sensory setae s 17–18 μm long (Fig. 1F). Thoracic segment I–III with 0, 2, 2 ventral setae respectively. Abdominal segment I–III each with 2+2 axial setae dorsally, setae m4 present on Abd. I, setae m3 and m4 present on Abd. II–IV (Figs. 1H–K). Abdominal segment IV without seta px and p4, setae m3 and m4 present, p1 (20 μm) about twice of p2 in length (Fig. 1K). Abdominal segment V with sensory seta p3 not differentiated (24–25 μm), seta a2 as mesoseta (16–17 μm), a4 as macroseta (28–30 μm), p4 as mesoseta (15 μm) (Fig. 1L). Crescentic ridges on Abd. VI absent. Abdominal segment VI with distinct dorsal secondary granulations and one small median process between the anal spines and visible ventrally (Figs. 1N, 2E, F). Anal spines locate on distinct papillae, 20 μm long (Fig. 2E, F).

Number of ventral setae on Abd. II, III and IV variable, with 18, 19–20, and 22–24 setae respectively. Ventral tube with 4+4 apical setae and 2+2 basal setae (Fig. 1M). Male genital plate with 3–4 pairs circumgenital setae and females unknown.

Etymology

We dedicate this new species to the late Professor Zhong Yang (1964–2017) who was an eminent botanist from Fudan University, for the memory of his great contribution to the knowledge of flora and biodiversity of Tibet.

Distribution

Known only from the type locality.

Remarks

The genus *Metaphorura* contains 10 species occurring in Holarctic areas (Bellinger et al, 1996–2019; Bu & Gao, 2017; Dunger & Schlitt, 2011). Only one species *M. motuoensis* Bu & Gao, 2017 was known from Southeast Tibet of China. *Metaphorura zhongi* sp. n. differs from *M. motuoensis* in the shape of PAO (17–18 vesicles in *M. zhongi* sp. n. vs. 14–16 simple roundish vesicles in *M. motuoensis*), formula of pso on the body (11/122/22221 in *M. zhongi* sp. n. vs. 11/111/11111 in *M. motuoensis*), the chaetotaxy of Abd. IV (seta a5 present in *M. zhongi* sp. n. vs. absent in *M. motuoensis*) and the length of sensory seta p3 on Abd. V (same length as p2 in *M. zhongi* sp. n. vs. shorter than p2 in *M. motuoensis*). It is also similar to *M. denisi* Simón Benito, 1985 and *M. riozoi* Castaño-Meneses, Palacios-Vargas & Traser, 2000 from Europe in the same formula of pseudocelli (11/122/22221). It differs from *M. denisi* in

the chaetotaxy of Abd. IV (seta p4 absent in *M. zhongi* sp. n. vs. present in *M. denisi*), shape of sensory seta p3 on Abd. V (as slender and long macroseta, same length as seta p2 in *M. zhongi* sp. n. vs. as slightly thickened mesoseta and distinctly shorter than seta p2 in *M. denisi*), number of setae on tibiotarsi I–III (10/10/10 in *M. zhongi* sp. n. vs. 11/11/10 in *M. denisi*) and the setae on anal lobes (setae I2' and I3' present in *M. zhongi* sp. n. vs. absent in *M. denisi*). It can be easily distinguished from *M. riozoi* by the shape of PAO vesicles (simple elongate vesicles in *M. zhongi* sp. n. vs. elongate bilobed vesicles in *M. riozoi*).

Acknowledgements

We give our cordial gratitude to Dr. Tian-Meng Liu who was a doctoral student of Professor Zhong Yang for his well organization of expedition to Tibet in November 2015. We also thank Dr. Gang Yang and Mr. Zheng-Wei Wang for their generous help during the collection. Special thanks are given to Dr. José G. Palacios-Vargas (Mexico), Dr. Wanda Maria Weiner (Poland) and Dr. Zhi Xiang Pan (China) for their valuable comments during the review of this manuscript. This research was supported by the National Natural Science Foundation of China (no: 31772509) and the Natural Science Foundation of Shanghai (no: 17ZR1418700).

Author's contributions

Yun Bu collected the specimens, prepared the slides, made drawings and pictures, and wrote the paper. Yan Gao identified the specimens, prepared the plates and wrote part of this paper.

Funding:

This study was funded by the National Natural Science Foundation of China (no: 31772509) and the Natural Science Foundation of Shanghai (no: 17ZR1418700).

Conflict of Interest:

The authors declare that there are no conflicts of interests.

REFERENCE

- Bagnall, R. S. 1936. The British Tullbergiinae. Part II. Entomologists Monthly Magazine, 72: 34–40.
- Bellinger, P.F., Christiansen, K.A. and Janssens F. 1996–2019. Checklist of the Collembola of the World, <http://www.collembola.org>, Accessed 15 January 2019.
- Börner, C. 1902. Das genus Tullbergia Lubbock. Zoologischer Anzeiger, 26: 123–131.
- Bu, Y. and Gao, Y. 2017. Study on Tullbergiidae of Tibet, China I. *Metaphorura*, *Mesaphorura* and *Prabhergia* (Hexapoda, Collembola). ZooKeys, 686: 85–94.
- Castaño-Meneses, G., Palacios-Vargas, J. G. and Traser, G. 2000. A new species of *Metaphorura* (Collembola: Onychiuridae: Tullbergiinae) from Hungary. Annals of the Entomological Society of America, 93: 1263–1266.
- Dunger, W. and Schlitt, B. 2011. Synopses on Palaearctic Collembola: Tullbergiidae. Soil Organisms, 83: 1–168.
- Fjellberg, A. 1991. Tibiotarsal chaetotaxy in Tullbergiinae (Collembola: Onychiuridae). Entomologica scandinavica, 21: 431–434.
- Qian, C. Y., Bu, Y., Dong, Y. and Luan, Y. X. 2018. Study on the Pauropoda from Tibet, China. Part I. the genera *Decapauropus* and *Hemipauropus* (Myriapoda). ZooKeys, 754: 33–46.
- Rusek, J. 1967. Beitrag zur Kenntnis der Collembola (Apterygota) Chinas. Acta Entomologica Bohemoslovaca, 64: 184–194.
- Rusek, J. 1971. Zur Taxonomie der *Tullbergia* (*Mesaphorura*) *krausbaueri* (Börner) und ihrer verwandten (Collembola). Acta Entomologica Bohemoslovaca, 68: 188–206.
- Rusek, J. 1982. European *Mesaphorura* species of the *sylvatica*-group (Collembola, Onychiuridae, Tullbergiinae). Acta Entomologica Bohemoslovaca, 79: 14–30.
- Simón Benito, M. C. 1985. Colémbolos de suelos de sabinar en la provincia de Guadalajara. EOS Revista Española de Entomología, 61: 293–318.
- Tamura, H. and Zhao, L. 1996. Two species of the subfamily Tullbergiinae in Xishuangbanna, southwest China (Collembola: Onychiuridae). Japanese Journal of Entomology, 64: 790–794.
- Weiner, W. M. and Najt, J. 1991. Collembola Poduromorpha de Nouvelle-Calédonie. 6. Onychiuridae Tullbergiinae. In: Chazeau J & Tillier S (Eds), Zoologia Neocaledonica, Volume 2. Mémoires du Muséum National d'Histoire Naturelle (A), 149: 119–130.